Arts and Science

Mathematics

Concordia University Loyola Campus

Faculty of Arts and Science

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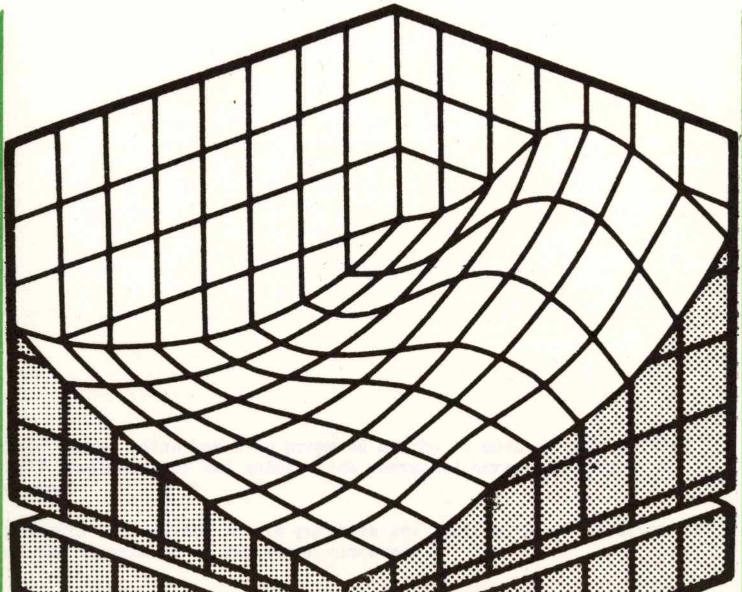

concordia university

DEPARTMENT OF MATHEMATICS

LOYOLA CAMPUS

COURSE GUIDE

This course guide has been prepared months in advance of the 1976-1977 academic year and information contained herein is subject to change.

Students are advised not to purchase any texts without the approval of the department of professor concerned.

FULL-TIME FACULTY

Associate Professor and
Chairman of Department

J. Soric, M.Sc. (McMaster)

Associate Professors

K.N. Majumdar, Ph.D. (Purdue)
A. Prillo, M.A. (Toronto)
T.N. Srivastava, Ph.D. (Gorakhpur, India)

Assistant Professors

M.V. Bobetic, Ph.D. (Waterloo)
L.S. Dube, Ph.D. (Carleton)
D. Kachroo, M.Sc. (McGill)
A. Keviczky, M.Sc. (City College of the City University of New York)
H. Kim, Ph.D. (McGill)
R. Smith, M.Sc. (Toronto)

Loyola Mathematics Department Information

The courses and programmes offered by the department attempt to give the student a balanced exposure to the main branches of Mathematics, similar to that given in all other Canadian universities. However, we feel that we can offer an excellent setting for the student to pursue studies - small classes and a friendly and helpful staff of high quality. The student will take some courses showing the historical development and applications of certain areas of Mathematics, and others involving current development and research. Both pure and applied mathematics courses are offered and the student's electives can be chosen to reflect his or her main interests. The honours programme is intended primarily to prepare a student for graduate studies. Students planning a career in business or industry are urged to take elective courses in applied mathematics, computer science, accounting, business and finance. In short, we attempt to show that mathematics is both an art form and a practical subject.

There are a certain number of core courses which must be taken in Mathematics programme. However, in the choice of electives, the students can direct the emphasis of their programmes towards pure mathematics, applied mathematics and physics, statistics, computer science, business and economics.

Mathematics is, of course, the language of science and many other science subjects have certain Mathematics courses as a required part of their programmes. There are many Mathematics courses available to the interested student as electives, some with little or no prerequisites. These could be taken as ancillary subjects to the student's own major, or solely for interest. The same applies to arts students. In the social sciences, particularly sociology, psychology and economics, mathematical methods and notation are being increasingly used. Calculus, statistics, linear algebra, differential equations are useful also in these subjects. Introductory calculus may be taken by an arts student with only a high school mathematics background. A survey mathematics course with no prerequisite is available as well for the interested arts student. For arts, commerce, or science students who may enter an MBA programme later, the core mathematics courses are very helpful.

Our Mathematics graduates have gone on into a wide variety of careers. Many honours programme students have continued their studies in graduate school, preparing for collegial or university teaching. Many majors and honours graduates also go into teaching (elementary or high school) after a further year's studies in education. A growing number of graduates go on to an MBA programme. Others have entered unrelated fields such as medicine or law. However, the great majority of graduates have found excellent careers in business and industry, government, in insurance comapnies, and accounting firms, and as programmers and statisticians. To prepare for these careers, students are generally advised to take computer science, accounting, economics, marketing and management electives.

PROGRAMMES

credits	
102	B.Sc. or B.A. Honours in Mathematics
	Year I
3	Math 321A/B or Math Elec
18	Math323A/B, 326Z, 344Z 353A/B
3	Math Elec
6	Elec
6	Elec
	Year II
6	Math 340Z or 402Z
15	Math 426Z, 436Z, 451A/B
3	Math Elec
6	Elec
6	Elec
	Year III
9	Math 535A/B, 551A/B, 567A/B
15	Math Elec
6	Elec
90	B.Sc. or B.A. Specialization in Mathematics
	Year I
3	Math 321A/B, or Math Elec
15	Math 323A/B, 334Z, 340Z
3	Math Elec
9	Elec
	Year II
18	Math 326Z, 353A/B, 402Z 451A/B
3	Math Elec
9	Elec
	Year III
6	Math 436Z
12	Math Elec
12	Elec

42	B.Sc. or B.A. Major in Mathematics
	The following courses, in an approved sequence, constitute a Major in Mathematics
3	Math 321A/B or Math Elec
36	Math 321A/B, 326Z, 334Z,340Z, 353A/B, 402Z, 436Z
3	Math Elec
42	B.Sc. or B.A. Major in Statistics (Mathematics)
	The following courses, in an approved sequence, constitute a major in Statistics.
3	Math 321A/B or Math Elec
27	Math 323A/B, 305A/B, 334Z 340Z, 353A/B, 402Z
9	Math 405A/B, 502Z
3	Comp Sc 241A/B or Math Elec
24	Minor in Mathematics
24	Four courses approved by the Mathematics Department constitute a minor in Mathematics

Department of Mathematics

A "Mathematics elective" may be replaced by a course approved by the department.
Students who intend to follow a Mathematics Programme in University are recommended to take Mathematics 133, 135,231, 233 (Loyola) or Mathematics 103, 203,105 (CEGEP) at the collegial level.
A students wishing to follow a Mathematics Programme but not meeting these requirements should consult with the Department Chairman.
Students who have taken Mathematics 321 (Introductory Linear Algebra) or its equivalent at the collegial level, will have a Mathematics elective (half course) in its place. Students without a collegial half course in Linear Algebra take Mathematics 321 in University I.
By a careful choice of electives students can select whether the emphasis of the programme will be in the area of pure mathematics, applied mathematics or statistics.
The Mathematics Department offers the following courses, Mathematics 109A/B, 111A/B, 133A/B, 135A/B, 231A/B, 233A/B, as University credits for non-Science students (excluding Arts students who are following a Mathematics Programme)subject to the approval of each student's Departmental Chairman.
It is possible for a student to take the courses listed in the Honours and Specialization programmes in a sequence different from the one suggested, after obtaining the approval of the Department Chairman.

Mathematics 103

Mathematics for Elementary School Teachers (9 credits)

Description: A comprehensive course in Mathematics designed for teachers of elementary grades who are responsible for developing ideas of Mathematics with children and for parents interested in the basic concepts and philosophy of the New Mathematics. The course will be a laboratory approach to mathematics,content relevant to the elementary grades. Included will be elementary topics from sets, numeration, number operations and properties, geometry and number systems. The development of content will be combined with pedagogical implications through relevant applications to the classroom. This will be accomplished through discussion of learning theories, teaching strategies, consideration of and development of various materials of instruction and evaluative procedures. In general the course will be experimental with participants "doing" as well as "discussing". A wide variety of instructional materials will be utilized and course activity will be oriented toward an awareness of those materials available and their potential for the classroom.

Note: The course may be used as 9 credits at the University except for Mathematics students.

NOTE: Students planning a career in teaching should consult the Co-ordinator of Teacher Certification for information concerning certification.

Mathematics 107

Mathematics for Secondary School Teachers (9 credits)

Description: A comprehensive course in Mathematics designed for teachers of secondary school students. The course will be a laboratory approach to the teaching of mathematics with special emphasis upon the following topics: individualized instruction, teaching the slow learner, the use of media and instructional materials, project oriented instruction and evaluation. The development of various materials for instruction will be accomplished by the participant of the class and sources of supplementary materials will be made available. A wide variety of instructional materials will be utilized and course activity will be oriented towards an awareness of the materials which are potentially available for the use in the classroom.

Note: The course may be used as 9 credits at the University level except for Mathematics students.

See Note: Math 103

Mathematics 109 A/B

Intermediate Algebra (Pre-Calculus) (3 credits)

Description: The purpose of this course is to prepare students to take further courses in Mathematics such as Calculus for Science, Engineering, Business and Social Science students. Many of the topics are covered in High School functions. It is often taken by students whose Mathematics background is weak or rusty and do not feel ready to take Calculus yet. Topics covered include logarithms, ratio and proportion, arithmetic and geometric progressions, permutations and combinations, the binomial theorem and probability.

Text: Algebra and Trigonometry with Analytic Geometry by Cameron

Prerequisite: None

Mathematics 111 A/B

Trigonometry and Analytic Geometry (Pre-Calculus) (3 credits)

Description: This course together with Mathematics 109 A/B form the pre-calculus stream and prepares students for further courses in Mathematics. Topics covered include: trigonometric functions, right-angle triangles, trigonometric identities, solutions of triangles, slope of a straight line, equations of a straight line, circles, parabola, ellipse and hyperbola.

Text: Algebra and Trigonometry with Analytic Geometry by Cameron

Prerequisite: None.

Mathematics 133 A/B

Calculus I (3 credits)

Description: This subject differential calculus was developed to study variable quantities and to answer such questions as "how fast does the quantity vary", "what is the maximum value of the quantity", "When is it increasing and when is it decreasing". Topics covered include straight line, slope of a curve, derivative, differentiation formulas, chain rule, implicit differentiation, applications, curve sketching, related rates, maxima and minima, antiderivative and area under a curve. The students will be expected to develop a feeling for the central notion of limiting process throughout the calculus stream 133, 135, 231, 233.

Text: Analytic Geometry and the Calculus by A.W. Goodman, 3rd edition

Assignments & Grading : Two class tests worth 40% and the final examination worth 60%, or just the final examination worth 100% if this mark is higher.

Prerequisite: Mathematics 109 A/B, 111 A/B or the equivalent (Functions)

Mathematics 135 A/B

Calculus II (3 credits)

Description: The main new notion in this course is that of the area under a curve again approached as a limiting process. The topics covered are : integration and applications, the derivative and integral of trigonometric, exponential, and logarithmic functions, methods of integration.

Text: Analytic Geometry and the Calculus by A.W. Goodman, 3rd edition

Assignments & Grading : Two class tests worth 20% each and the final examination worth 60%, or just the final examination worth 100% if this mark is higher.

Prerequisite: Mathematics 133 A/B

Mathematics 231 A/B

Calculus and Vector Geometry (3 credits)

Description: The main subject of this course is vectors in two and three dimensions, but the course begins with the methods of integration if these were not completed in Mathematics 135. This course is not a course in abstract vector spaces (see Mathematics 321). Topics covered in this course are: vectors in the plane, vectors and parametric equations, differentiation of vectors, vectors and solid analytic geometry, equations of lines in space, scalar product, cross product, equations of planes and surfaces. Other topics covered include polar co-ordinates, translations and rotation of axis.

Text: Analytic Geometry and the Calculus by A.W. Goodman, 3rd edition.

Assignments & Grading: Two class tests worth 20% each and the final examination worth 60%, or just the final examination worth 100% if this mark is higher.

Prerequisite: Mathematics 133 A/B and 135 A/B

Mathematics 233 A/ B

Calculus III (3 credits)

Descriptions: This course is a continuation of the study of calculus. The key notion of a limiting process will begin to be approached more rigoursly. Topics covered include: L'Hôpital's rule, improper integrals, sequences, infinite series, geometric series, power series, tests for convergence, alternating series, Taylor's theorem, functions of several variables, partial derivatives.

Text: Analytic Geometry and the Calculus by A.W. Goodman , 3rd edition

Assignments & Grading: Two class tests worth 20% each and the final examination worth 60%, or just the final examination worth 100% if this mark is higher.

Prerequisite: Mathematics 231 A/B

Mathematics 300Z

Ideas in Mathematics (6 credits)

Description: "Ideas in Mathematics" is designed for students who think they probably don't like Mathematics but would be prepared to give it a second chance. The course provides you the opportunity to discover and explore some of the fundamental ideas in Mathematics, and to see the extent and power of Mathematics through some of its many applications. The topics covered will be chosen in consultation with the class and presented in a way that requires a minimal mathematics background.

Classroom Activity: You will have the opportunity to work at your own speed in small groups or by yourself on a variety of exercises, which are arranged according to level of difficulty. Lectures will be kept to a minimum and most of the time will be spent in workshop type activities and discussion.

Content: Some of the topics covered might include the mathematical way of thinking, induction and deduction, the mathematics of chance, and introduction to statistics.

Method of Evaluation: There will be periodic quizzes based on the material covered in class, which will contribute 40% to the final grade. There will be two projects, one in each term, which will make up the remaining 60%. These projects are designed to allow you to explore in depth some particular topic of interest related to you that is, in some way to mathematics. They might take the form of an essay, a series of problems, or a presentation to the class.

Text: The basic text for the course is Mathematics - A Human Endeavor, H.R. Jacobs

Prerequisite: This course has no formal prerequisites and does not serve as a prerequisite for any other Mathematics courses. Students who have had Calculus would probably not find this course challenging and are discouraged from taking it.

Mathematics 301 A/B

Elementary Statistics (3 credits)

Description: The purpose of this course is to introduce students to the fundamentals of statistics so that they can make sense of the data that arises from their experiments. This course is primarily for science students (non-mathematics):students in commerce, psychology, sociology, accountancy may not take this course if they take an equivalent course in their own department. Calculus is not required for this course. Topics covered include: empirical frequency distributions and descriptive measures, elementary probability, populations, samples and theoretical distributions, sampling distributions, estimation of confidence intervals, tests of hypotheses, two sample techniques.

Text: T.B.A

Prerequisite: None

Mathematics 305 A/B

Introduction to Discrete Probability Theory (3 credits)

Description: A basic formation for statistics, operations research and systems analysis requires a good background of probability theory. To get an insight into the subject a first course of discrete probability theory becomes essential. The course will include such topics as: discrete sample space, evaluation of probabilities using combinatorial arguments, occupancy and ordering problems, binomial and poisson distributions, expectations and variance of discrete random variables, random walk problems.

Text: References - 1) Probability by Dwass
2) Introduction to Probability Theory and Its Applications by Feller

Assignments & Grading: Class work worth 60% and the final examination worth 40%.

Prerequisite: Mathematics 231 and 233 or CEGEP equivalent

Mathematics 310Z

Mathematics for the Social & Management Sciences (6 credits)

Description: This course shows the uses of mathematical techniques applied primarily to business applications. For example, one of the central ideas of calculus, the derivative or rate of change, is used in finding maxima and minima of cost, revenue, and profit functions. The approach is intuitive and empirical rather than mathematically sophisticated. Other topics covered include: elementary algebra and breakeven analysis, straight lines, introduction to vectors and matrices, algebra of square matrices, exponents, logarithms and some important nonlinear functions, differentiation and integration, simple applications, introduction to probabilities.

Note: This course may not be taken by students who have had Mathematics 133 and 135, or their equivalent.

Prerequisite: Mathematics 109, 111 or its equivalent

Mathematics 311 A/B

Elementary Statistics II (3 credits)

Description: This course is a continuation of Mathematics 301. It is intended for those students who wish to continue their studies in statistics beyond the required first course, 301. The topics covered are mathematical expectation, curve fitting, statistical inference, inference from small samples, linear regression and correlation, analysis of enumerative data, design of experiments, the analysis of variance, nonparametric statistics.

Prerequisite: Mathematics 301, or permission of the department.

Mathematics 321A/B

Linear Algebra (3 credits)

Description: This course will give students a broad technique for solving linear equations that arise in all places of life. The methods introduced in this course are extensions and generalizations of properties of the three dimensional observable world. In particular the course contains the following: systems of linear equations, determinants, matrices, operators, vector spaces, and construction of basis vectors of a space.

Text: O'Nan, Linear Algebra

Prerequisite: None

Mathematics 323 A/B

Linear Algebra (3 credits)

Description: The course continues the elementary course Mathematics 321. The topics covered include: vector spaces, bases, dimension, linear mappings, matrices and linear operators, Eigen-values and eigen-vectors, canonical forms, inner product spaces.

Text: O'Nan, Linear Algebra

Prerequisite: Mathematics 321 A/B or its equivalent

Mathematics 326Z

Modern Abstract Algebra (6 credits)

Description: Modern algebra is an abstract generalisation of classical algebra, containing classical algebra in its core. The aim of the course is to introduce students to the basic concepts of abstract algebra and to familiarise them with abstract logical thinking needed in some parts of present day mathematics. The course covers considerable amount of group and ring theories and some elements of fields.

Text: A First Course in Abstract Algebra by J.B. Fraleigh, Addison Wesley Publishing Co.

Assignments & Grading : Home assignments are an integral part of the course. Students solve the assigned problems at home and return them for correction. There are some class tests and a 3 hour final examination.

Prerequisite: Classical algebra courses as given in Cegeps. A course in Linear Algebra is desirable.

Mathematics 329 A/B

Mathematics of Finance (3 credits)

Description: This course is a practical course on money matters. A typical problem would be"A finance company advertises loans of $99.40 to be repaid in 12 monthly installments of $10. each. Find the effective rate of interest charged." The mathematics involved is very simple. The course is required for anyone thinking of becoming an actuary, but anyone can profit from it, since it is useful in everyday life. Some of the topics covered are: simple interest, partial payments, installment buying, compound interest, present value, equations of value,ordinary annuities certain, amortization of a debt, sinking funds, depreciation, bonds, premium and discount, deferred annuities, perpetuities.

Prerequisite: Mathematics 109 A/B or Functions

Mathematics 332Z

Advanced Calculus and Differential Equations for Chemistry students.

Description: The course is made up of an introduction to Differential Equations and topics in Advanced Calculus. The only prerequisite for any of the topics treated is calculus. The Differential Equations part outlines both the classical theory of differential equations and the more modern techniques currently available. The modern techniques have become feasible, of late, due to the advent of high speed computers which has made solutions by numerical techniques simple. Some of the applications of the easier techniques include solutions of the following types of problems: problems in coding, Growth and decay problems, Dilution problems, Steady heat flow problems, Othogonal trajectories. The topics in Advanced Calculus will be highlighted by a discussion of Green's, Stoke's, and Gauss theorems(which find their applications, especially, in a course of Physical Chemistry),the work integral, The transport of heat and momentum, Electricity and magnetism.

Text: Modern Introductory Differential Equations by Richard Bronson. Schaum's Outline Series and Advanced Calculus by Murry R. Spiegel Schaum's Outline Series.

Assignments & Grading: Three tests in each semester will be given, which will account for fifty percent of the final mark.

Prerequisite: Calculus

Mathematics 334Z

Advanced Calculus (6 credits)

Description: This course is a continuation of CEGEP calculus. Many techniques, useful in Physics and Engineering, are covered in this course. The ideas of calculus are expanded to functions of several variables, but with more rigour than in the CEGEP calculus. Topics covered include: functions of several variables, limits, continuity, partial derivatives, maxima and minima, extremal problems with constraints, differentiability. Taylor's series, double and triple integrals, curves and surfaces, line and surface integrals, Green's theorem and Stokes' theorem. The course is compulsory for Mathematics, Computer Science and Physics students, but may be taken by other students (excluding Engineering students) who have taken CEGEP calculus.

Text: Advanced Calculus by Taylor, 2nd Edition

Prerequisite: Mathematics 231 & 233 or Mathematics 103, 203 (CEGEP)

Mathematics 340Z

Numerical Methods (6 credits)

Description: "Numerical Methods" is designed to enable you to answer many of the questions that are left over from other Mathematics courses you have taken. In finding maximum or minimum values you must compute the zeros of the derivative function; but so far they were usually simple. What about the realistic and somewhat more difficult ones e.g. $x - 6x + 5 = 0$ or $e^x + \sin x = 0$. There are many integrals, even simple looking ones, which you are still unable to evaluate even after two courses in Calculus, e.g. $\int_0^1 e^{x^2} dx$. There are also the problems of finding the solution to systems of equations and inverses of matrices, to name but a few more. The purpose of Mathematics 340 is to introduce you to the standard numerical techniques, and their applications, and to explore in detail their mathematical foundations. Although the computer plays an essential role in the large-scale application of numerical methods, all of the problems studied can be solved with the aid of a calculator.

Content: Some of the topics covered include the evaluation of polynomials and their derivatives, polynomial approximation, zeros of functions, numerical differentiation and integration, systems of algebraic equations and matrix inversion.

Method of Evaluation: The final grade is based on two exams, midterm and final, based on the two halves of the course. You must pass these exams to pass the course. Students who do poorly in the midterm have the opportunity to write a make-up exam on the first term material at the end of the course. If you have passed the exams your final grade can be improved by as much as 25% on the basis of assignment problems.

Text: First Course in Numerical Methods, Jennings

Prerequisites: At least 2 courses in Calculus.

Mathematics 353A/B

Ordinary Differential Equations (3 credits)

Description : This course is an introduction into one of the most fruitful languages of science, namely the differential equation. The occurrence of differential equations in real life situations is elaborated. The course revolves around the following topics; first order differential equations with emphasis on exactness, linear constant coefficient differential equations with some applications to electrical circuits, solutions of non-homogeneous differential equations by construction of inverses of differential operators.

Prerequisite: Mathematics 231, 233 or Mathematics 103, 203 CEGEP

Mathematics 368Z

Actuarial Mathematics (6 credits)

Description: This is an elective course for anyone interested in seeing elementary mathematics applied to life insurance and related areas. It is very useful for anyone possibly interested in becoming an actuary. Topics covered in this course include: the measure of mortality, life annuities, life insurance, net annual premiums, net level premium reserves, the expense factor, special topics, population theory.

Text: The Society of Actuaries Textbook on Life Contingencies by C.W. Jordon (2nd Ed.)

Prerequisite: Mathematics 329 A/B

Mathematics 371 A/B

Introduction to Logic (3 credits)

Description: Topics covered in this course include: logic and language, propositional calculus, validity and invalidity, formal proofs, propositional functions and quantifiers, predicate calculus, metamathematics.

Text: T.B.A.

Prerequisite: None

Mathematics 373 A/B

Set Theory (3 credits)

Description: The theory of sets lies at the foundation of mathematics. The concepts in set theory, such as functions and relations, appear in all branches of mathematics. The course starts with an informal treatment of the theory of sets and goes into more systematic and axiomatic parts of the theory. It covers cardinal and ordinal numbers, axiom of choice, Zorn's lemma and well-ordering theorem.

Text: Set Theory and Related Topics by S. Lipschutz

Assignments & Grading: Class tests worth 50% and a final examination worth 50%

Prerequisite: None

Mathematics 375 A/B

Combinatorics (3 credits)

Description: Combinatorial arrangements satisfying specified conditions are a fact of every day life. During the last 25 years or so, the mathematical methods used to form these arrangements and study their properties have been grouped to form this new branch of mathematics. The purpose of the course is to acquaint the students (without any previous background) to the methodology of Combinatorics. Topics include principle of inclusion and exclusion, generating functions used in counting the number of possible arrangements satisfying various specified conditions and other related items, Hall's theorem on distinct representatives and its applications. All the required machinery is developed in the course. It is useful for engineers, computer scientists (who might find the topics useful in their later work) and students of mathematics.

Text: Introduction to Combinatorial Mathematics by C.L. Liu, McGraw Hill.

Assignments & Grading: Some home assignments and a 3 hour examination

Prerequisite: A course in Advanced Calculus is preferable. It is strongly suggested that students concurrently take a course in Advanced Calculus.

Mathematics 377 A/B

Introduction to Game Theory (3 credits)

Description: Matrix games, strategies, optimun strategies and the value of a game. Strictly determined games, non-strictly determined games and linear programming, applications. Further material according to the interest of the instructor and the students.

Prerequisite: None.

Mathematics 401A/B

Mathematics for the Biological Sciences I (3 credits)

Description: The recent past has seen a rapid rise in applications of varied mathematical tools to the study of many different kinds of biological phenomena. The purpose of this course is to develop the student's ability to relate mathematics to problems in biology and medicine. This course does not include a general discussion of statistical methods, since these topics are covered in the courses, Mathematics 301 and Mathematics 311. The topics covered in this course are: binomial, multinomial, and Poisson distributions; vectors, matrices, eiginvalues; linear programming and simplex method.

Text: Mathematics for Biological Sciences by Grossman & Turner.

Prerequisite: Mathematics 133 and 135, or equivalent.
Enrollment in a Biology program.

Mathematics 402Z

Mathematical Statistics (6 credits)

Description: Statistics no longer consist merely of the collection of data and their presentation in charts and tables; it is now considered to encompass not only the science of basing inferences on observed data, but the entire problem of making decisions in the face of uncertainty; e.g. when a doctor experiments with a new drug, when an economist forecasts business cycles, when a newspaper predicts an election, etc. Modern statistics provides a framework for looking at these situations in a logical and systematic fashion; i.e. provides a model. Practical problems and theory are both stressed in this course. Topics covered include: frequency distribution, averages and measures of dispersion, introduction to probability theory, random variable and mathematical expectation, moments and moment generating functions, discrete and continuous distributions, estimation and small sampling theory, testing of hypothesis, curve fitting and correlation theory.

Text: Probability and Statistics for Engineers and Scientists by Walpole and Myers
Mathematical Statistics by J. Freund

Assignments & Grading: The term work will be worth 60% and the final examination worth 40%. The term work will be based on assignments or class tests and the final will be based on the theoretical part.

Prerequisite: Mathematics 231 and 233

Mathematics 403 A/B

Mathematics for the Biological Sciences II (3 credits)

Description: This course is a continuation of Mathematics 401. Markov chains and game theory, two of the topics covered, have become important tools in ecology, medical diagnosis and treatment, genetics, and many other areas. Difference equations are an essential technique in describing processes of population growth and in many genetics applications. Another topic covered is mathematical models in biology, those relating to the basic problem of the growth, survival, and extinction of populations.

Text: Mathematics for Biological Sciences by Grossman & Turner.

Prerequisite: Mathematics 401

Mathematics 405 A/B

Stochastic Processes (3 credits)

Description: Stochastic or random processes abound in nature. Whenever one examines a process in time, controlled by the laws of probability - such as the growth and decay of populations, the spread of epidemics, the varying traffic of a telephone exchange or the fluctuating emission of radio-active particles - one observes a stochastic process, i.e. the phenomena that evolve as random functions of time. The topics include a certain coverage of stochastic processes for their application in economics, biometrics and demography and other fields of science. The following subjects will be covered: continuous time stochastic processes, poisson processes, continuous time Marcov processes, queing models, birth and death processes, renewal theory and reliability systems.

Text: T.B.A.

Prerequisite: Mathematics 305 A/B

Mathematics 415 A/B

Boolean Algebra (3 credits)

Description: Boolean algebra is a part of modern algebra which has proved to be very useful in designing electrical switching circuits for computers and communication networks. The course aims at introducing students (who have no previous acquaintance with abstract mathematics) to the basics of Boolean algebra. It begins at the beginning. Abstract Boolean algebra is developed as much as needed for applications. Applications to switching ciruits is an interesting part of the course. This course is useful to engineering and computer science students amongst others.

Text: Boolean Algebra and its Applications by J.E. Whitesitt, Addison Wesley Co.

Assignments & Grades: Some home assignments and a 3 hour final examination.

Prerequisite: Some acquaintance with a course in modern algebra is desirable but not essential.

Mathematics 426Z

Algebra II (6 credits)

Description: The subject of algebra was begun thousands of years ago by ancient Egyptians and Babylonians. Throughout the years, one of the main problems in algebra has been solving equations. The quadratic formula was discovered by the Greeks; the cubic and quartic formulae were not discovered until the 16th century. Since then people tried to solve general polynomial equations, in particular, the next one, namely the quintic. Galois discovered in the early 19th century that the answer to this question is negative:"the quintic equation is not generally soluble by radicals". This is the main objective of this course. Topics covered in this course also include abelian groups, composition series, and rings.

Text: A First Course in Abstract Algebra by J.B. Fraleigh

Assignments & Grading: Grading will be determined in the class.

Prerequisite: Mathematics 326Z

Mathematics 436Z

Real Analysis (6 credits)

Description: This is a course in rigorous mathematical analysis covering the fundamental concepts of metric spaces introduced through topological spaces. It begins with set theory. Topics are :theory of sequences and series ,continuous and differentiable functions in metric spaces, uniform convergence of sequence and series of functions and other standard items of real analysis.

Text: Principles of Mathematical Analysis by Walter Rudin, McGraw Hill

Assignments & Grading: Home assignments form an essential part of the course. On the average, about 2 home assignments are given per month, the solution of the problems are discussed in class. There are some class tests and a final 3 hour examination.

Prerequisite: A course in Advanced Calculus.

Mathematics 445 A/B

History of Mathematics (3 credits)

Description: The course treats the major mathematical creations and developments from ancient times to the twentieth century. The central ideas, those influential in shaping subsequent mathematical activity, are stressed, as well as the changes in the concept of mathematics itself. It is hoped that this course will give perspective to the various mathematics courses a student has taken, which themselves are segments of mathematics that seem to have little relationship to each other. Some of the major themes covered will be: Euclid and classical Greek mathematics; Newton, calculus, and the mathematization of science; projective and non-Euclidean geometry; the development of rigour in analysis; the development of abstract algebra; the foundations of mathematics and axiomatization.

Prerequisite: Several mathematics courses or an interest in mathematics.

Mathematics 451A/B

Complex Analysis(3 credits)

Description: The objective of this course is to give students one of the most important tools for understanding physical phenomena. This method can best be described as a geometric approach. Integral representations of the solutions of basic equations of mathematical physics are discussed. Highlights of this course are: geometric signifance of complex numbers and complex valued functions, differentiability of functions of a complex variable, Cauchy integral formula, Taylor and Laurent series, residues with emphasis upon practical applications for evaluating non-standard integrals.

Prerequisite: Mathematics 334Z

Mathematics 471 A/B

Projective Geometry (3 credits)

Description: Topics covered in this course include: basic definitions and results, collineations, affine planes, perspectivities, Desargues and Pappus postulates and Hessenburg's theorem. Incidence matrices of finite projective planes and orthogonal Latin squares, coordinates in projective planes, examples of non-Desarguesian projective planes.

Text: T.B.A.

Prerequisite: Mathematics 326Z and Mathematics 321 A/B

Mathematics 473 A/B

Ordinary Differential Equations II (3 credits)

Description: This course is a continuation of Mathematics 353, whose purpose is to give students a more polished approach to the subject of differential equations. Tools developed in other courses are integrated into this course to construct solutions of differential equations. Emphasis is placed upon series solutions of differential equations and the problems arising from the convergence of these series. Some existence and uniqueness questions are discussed in order that the student may have an understanding of a wider field of differential equations.

Prerequisite: Mathematics 353 A/B

Mathematics 502Z

Experimental Statistics (6 credits)

Description: This course is a continuation of Mathematics 402Z and is designed for those students who want to work in industry as statisticians or go for graduate work, or simply further their knowledge of statistics. The following example shows a use of the course. Consider an experiment in which three varieties of wheat are planted on several acre lots and their yields per acre recorded. We are interested in testing the null hypothesis that the three varieties of wheat produce equal yields on the average. The yield may vary in part due to different types of soil on which wheat is planted. How to design the experiment such that the source of variation is eliminated. A new technique called Analysis of Variance will be discussed.In the first semester the topics multivariate analysis and fitting of linear models to the data will be covered. In the second semester the topic analysis of variance and sampling techniques will be covered. A very good background of linear algebra is required for this course. The content covered will include: basic concepts of sampling, simple, stratified, systematic sampling, optimum allocations, ratio estimates, matrix derivatives, multivariate normal distributions, linear models, analysis of variance, one-way and two-way classification, Latin square design.

Text: No special text book covers all the topics included in this course. The following books may be referred to:

1) Elements of Sampling Theory by Barnette
2) Sampling Theory of Surveys & Applications by Sukhatne & Sukhatne
3) Linear Models by Graybill
4) Probability and Statistics by Giri

Assignments & Grading: The examination is based on the class work (60%)and one written examination of three hours (40%).

Prerequisite: Mathematics 402Z

Mathematics 505 A/B

Industrial Statistics (3 credits)

Description: This course is intended for students wishing to see how statistics is applied in business and industry. Topics covered are concepts of statistical controls: X,R,P, and C charts; acceptance sampling; sequential probability ratio tests; sampling inspection; continuous sampling plans; reliability and life tests.

Prerequisite: Mathematics 402Z

Mathematics 526Z

Algebra III (6 credits)

Description: The main objective of this course is to discuss basic properties,of categories, functors and natural transformations. These concepts were introduced in mathematics in the early 1940's. Since then the concepts have been very rigorously studied and they are applied to many branches of mathematics. This topic can be safely called the bridge between "modern" algebra and "today's" algebra. Other topics covered in this course are: groups, rings, modules, and lattices.

Text: Algebra by S. MacLane and G. Birkhoff

Assignments & Grading: Grading will be determined in the class.

Prerequisite: Mathematics 326Z

Mathematics 535 A/B

Measure Theory and Integration (3 credits)

Description: The Lebesque integral and the classical problems it lays to rest; an exploration of more general theories of measure and integration in view of their mathematical clarifications or their applications. Topics covered include measure, outer measure, measurable sets, non-measurable sets, Lebesque integration, convergence, differentiation.

Text: T.B.A

Prerequisite: Mathematics 436Z

Mathematics 540Z

Numerical Analysis (6 credits)

Description: "A mathematician knows how to solve a problem - but he cannot do it" W.E. Milne. A prerequisite for the course 540, Numerical Mathods (340) - shows a way how to disprove the quoted Milne statement. However there still remains the problem how to justify theoretically those methods. For instance knowing how to use different types of interpolations may simply give the impression that the interpolation is the art of reading between the lines. Numerical analysis shows that this is not only an art, but a science as well. In other words, the N.A. is a scientific and theoretical background for those numerical methods. The course 540 is an introductory course, however: therefore it must describe different numerical methods but also the properties of these methods. The course does not contain hard-boiled mathematics; however, it does contain a sufficient and necessary stringency. It rather follows what Voltaire said: "Le secret d'ennuyer est celui de tout dire." Besides the topics listed in the calendar the course 540 also includes the Monte Carlo Method which involves the use of statistical sampling techniques to approximate the solution of mathematical and physical problems.

Text: 1) A First Course in Numerical Analysis 2) Analysis of Numerical Methods

Assignments & Grades: The final mark is based on the individually worked problems, optional seminar and/or final exam. It is absolutely essential that every student work independently and hand in a set of the problems of the practical and theoretical nature. This may account up to 70% of the final mark. The seminar on the specific topic is optional and it may replace the final exam. The final exam is based rather on the general knowledge and understanding of the basic concepts of the Numerical Analysis.

Prerequisite: Mathematics 340Z or special permission of the Professor

Mathematics 551 A/B

Complex Analysis II (3 credits)

Description: Analytic continuation, maximum modulus theorem and its application, argument principle, Rouche's theorem, conformal mapping, entire functions.

Text: T.B.A.

Prerequisite: Mathematics 451 A/B

Mathematics 567 A/B

Topology (3 credits)

Description: Topology developed as the fundamental ideas of analysis were explored to their foundations. The approach to topology in this course is as the generalization of analysis, as opposed to another possible approach, namely as a generalization of geometry. The central notion is that of continuity and topological spaces are regarded primarily as carriers of such functions and as domains over which they can be integrated. Metric spaces are studied first, and then generalized to topological spaces. This course, a standard undergraduate course in point-set topology, covers the following topics: metric spaces, spaces of continuous functions, topological spaces, basis and subbasis, products of spaces, continuity, compactness, separation, axioms, connectedness, and approximation .

Text: Introduction to Topology and Modern Analysis by G.F. Simmons

Prerequisite: Mathematics 436Z or permission of the instructor

Mathematics 571 A/B

Algebraic Topology (3 credits)

Description: Topics covered include: homotopoy theory, fundamental groups, classification and polygon representation of the topological surfaces, orientability, handles and cross caps, triangulation, simplexes, chains and normal forms, homology theory.

Text: T.B.A.

Prerequisite: Mathematics 326Z, 567 A/B

Mathematics 575 A/B

Senior Thesis (3 credits)

Description: Under special circumstances, approval will be given to undertake a research problem requiring independent work. The results will be directed and evaluated by a member of the department.

Prerequisite: Approval of the Department Chairman.

Mathematics 577 A/B

Functional Analysis (3 credits)

Description: A short review of the algebraic concepts, Banach space, definitions and examples, continuous linear transformations. Hahn-Banach theorem. The natural embedding of N into N^{**}. Hilbert spaces, definitions and examples. Orthonormal sets the conjugate space H^{*}. The adjoint of an operator, self adjoint operators, normal and unitary operators, projections, finite dimensional spectral theory.

Prerequisite: Mathematics 567 A/B

Mathematics 579 A/B

Calculus of Variations (3 credits)

Description:	"Le Mieux est l'ennemi du bien"— Voltaire. Extending this idea we can say that the calculus of variations is making "le meilleur" of the "mieux" and of the "bien". Suppose you are to construct a mechanical pendulum clock of the greatest possible accuracy. Soon you will discover that the bob moving along a circular arc is "bien", however not "le meilleur". The calculus of variations gives you a curve, the brachistochrone , along which the pendulum bob has to descend in the shortest possible time. And many more interesting examples from mechanical problems, chemical reactions to electrical oscillations and optimal control methods are covered. The course 579 is an introductory half course, thus combining both the classical theory of the calculus of variations with its applications. It does not contain excessive abstractions, but the approach is rigorous. The course follows the classical variational methods with the emphasis on geometric and physical problems. Some of the topics include: canonical Euler's equations, the principle of least action, Hamilton-Jacobi equation, the Weierstrass extrema conditions, the variational methods in problems of optimal control.

Text: Calculus of Variations by Gelfand and Fomin

Assignments & Grades:	The final mark is based on the work done on a set of theoretical and practical problems, optional seminar and the final exam. The distribution ranges between 70% and 30%, respectively.
Prerequisite:	Mathematics 334Z

Mathematics 581 A/B

Number Theory (3 credits)

Description:	Topics covered in this course include: arithmetical functions d(n), o(n), ϕ(n) and their formulas, Mersenne numbers, perfect numbers. Congruences, Fermat theorem, Euler- Fermat theorem, Wilson's theorem, divisibility properties of products of consecutive integers, linear and quadratic congruences, law of quadratic reciprocity, möbius functions, möbius inversion formula, Gauss theorem on ϕ(n), Gauss theorem on primitive roots.

Text: Topics in Number Theory , Vol. 1, LeVeque

Prerequisite: None

MATHEMATICS FOR

ENGINEERING STUDENTS

Engineering Mathematics 312

Differential Equations for Engineers (6 credits)

Description: Differential Equations furnish extremely powerful mathematical techniques for analyzing functional relations. Moreover, so vast is the field of their applications that the practical side rivals in importance purely theoretical consideration. Over the past years there have been significant developments in the field of differential equations. The advent of high speed computers has made solutions by numerical techniques feasible and has resulted in a host of new methods. This coiurse outlines both the classical theory of differential equations and the more modern techniques currently available. The only prerequisite for any of the topics treated is calculus. Some of the applications of the easier techniques include solutions of the following types of problems: Problems in coding, Growth and decay problems, Falling bodies with air resistance, Dilution problems, Electrical circuits, Vibrating springs, Orthogonal trojectories.

Text: Modern Introductory Differential Equations by Richard Bronson. Schaum's Outline Series.

Assignments & Grading: Three tests in each semester will be given, which will account for fifty percent of the final mark.

Prerequisite: Calculus

Engineering Mathematics 332

Matrices and Advanced Calculus

Description: Matrix algebra, characteristic value problems, diagonalization of Hermitian matrices. Cayly-Hamilton theorem and applications, quadratic forms, vector calculus.

Lectures: 3 hours per week

Tutorials: 2 hours per week

Prerequisite: Engineering Mathematics 312 previously or concurrently.

Engineering Mathematics 352

Complex Variables

Description: Algebra of complex numbers in Cartesian and polar forms, functions and inverse functions of complex variables. Derivatives and Cauchy-Riemann, analytic and harmonic functions. Exponential, trigonometric, hyperviolic and logarithmic functions. Complex line integrals, Cauchy-Qoursat theorem, Cauchy integral formula. Taylor's and Laurent's series. Residue theorem and application.

Lectures: 3 hours per week

Prerequisites: Engineering Mathematics 312, Engineering Mathematics 332 previous or concurrently.

Engineering Mathematics 371

Statistics for Engineers (3 credits)

Description: This course is specially designed for Engineers. Emphasis is given to the theory of distributions, estimation theory and testing of hypothesis. Statistics is widely used by mechanical, chemical and electrical engineers. But this course may be of interest to those who are in Physics and other branches of science provided they have calculus. Topics to be covered will include: introduction to probability theory, frequency distribution, average and measure dispersions, discrete and continuous distributions, estimation theory and testing of hypothesis, small sample theory.

Text: Introduction to Statistics by Walpole

Assignments & Grading: Class work worth 60% and final examination worth 40%